Mole
The Black House 2002 (where I live)

- Prefabricated timber frame
- Low embodied energy
- Recycled materials
- Shading devices
- ASHP
- MVHR

Calculated primary energy
140 kWh/m²/year

Calculated heat loss
38 kWh/m²/year

(Current B Regs house calculated heat loss
55 kWh/m²/year)
Affordable Passivhaus 2009
Norfolk

- Prefabricated timber frame
- Shading devices
- Triple glazing
- No heating system
- MVHR

Calculated primary energy
60 kWh/m²/year

Calculated heat loss
12 kWh/m²/year

(Current B Regs house calculated heat loss 55 kWh/m²/year)
Eddington 2012

- Code Level 5
- Low energy use
- High thermal mass
- Triple glazing
- District heating
- High natural light levels

(Current B Regs house calculated heat loss 55 kWh/m2/year)
Marmalade Lane 2018

Land sale of City owned land
Tender requirement to build to high environmental standard

- Prefabricated timber frame
- Low embodied energy
- CLT Frame
- Triple glazing
- ASHP
- MVHR

Calculated primary energy
90 kWh/m²/year

Calculated heat loss
17 kWh/m²/year

(Current B Regs house calculated heat loss 55 kWh/m²/year)
Cambridge City Council

Land sale of City owned land

Tender requirement to build to high environmental standard

Hill Residential scheme with Pollard Thomas Edwards Architects

- zero carbon to Passivhaus standards
Norwich City Council

Development of City owned land

100% houses for social rent

Designed by Mikhail Riches Architects to Passivhaus standards

Shortlisted for the 2019 RIBA Stirling Prize
Near Zero Carbon

All emissions, including those from unregulated energy use

All emissions from regulated energy use

Emissions standard for Carbon compliance

Allowable Solutions

On-site LZC Heat and Power

Fabric Energy Efficiency

These emissions are no longer included in the 2016 definition for Zero Carbon homes

* source:
Zero Carbon Hub/ Tom Dollard PTEa
Near Zero Carbon

* source: Zero Carbon Hub/ Tom Dollard PTEa
The total energy demand for our 2020 ASHP house is 4,300 kWh/year and with our 16 solar panels, the total generation is also 4,300 kWh/year. So, we would appear to have a Zero Carbon building. However, unfortunately, it's not that simple. If we are to get to true zero, we need to consider the Performance Gap, seasonality of renewable generation and associated storage losses, how much renewable energy we can realistically generate and the impact on the electricity grid.

The Performance Gap

There is clear evidence that the actual energy performance of our new homes does not match with the design. Appendix 2 sets out the evidence and demonstrates that the average home is likely to use around 40% more energy than predicted, with heating demand sometimes 2 to 3 times greater. If we include the impact of the performance gap to reflect the way in which our buildings are actually performing, then our demand increases to 5,400 kWh/year, which requires 20 solar panels to offset.

In contrast, the quality assurance process that is part of the Passivhaus standard ensures that what is designed is what gets built and the actual energy performance of Passivhaus homes is, on average, exactly as predicted by the design stage modelling. In short, Passivhaus buildings do not suffer from a performance gap.

It could be argued that much of the data relating to the Performance Gap is now historical and we shouldn't be basing future policy on this basis. Whilst there is no one single root cause of the gap, much of it is due to quality control on site – ensuring high quality construction and that the right materials are used in the right places. To achieve this, we need more robust assurance regimes, incentives for better buildings and penalties for those that do not perform. Unless policies are put in place to achieve these, then it is reasonable to assume that we are likely to see the Performance Gap endure in our new homes for some time to come.

*source: Passivhaus Trust Route to Zero Carbon
Northstowe
10,000

Waterbeach (U+C)
6,500

16,500 total
Waterbeach (Turnstone)
4,500

Alconbury
7,000

28,000 total
Wing
1,300

Marshalls
12,000

41,300 total
Eddington
3,000

Cambourne West
2,350

46,550 total
Bourne
3,500

North Ely
3,000

53,050 total
Wintringham
2,800

Darwin Green
1,600

57,450 total
Welcome Trust

1,500

58,950 total
Barratt £38K
Taylor Wimpey £54K
Persimmon £50K
Bellway £56K
Berkeley £119K
Redrow £55K
Galliford Try £44K
Bovis £40K
Crest Nicholson £70K
L&Q £45K
Countryside £46K
Bloor £44K
<table>
<thead>
<tr>
<th>Local Authority</th>
<th>Target</th>
<th>Additional Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambridge</td>
<td>19% reduction on Part L 2013</td>
<td></td>
</tr>
<tr>
<td>Greater Manchester</td>
<td>19% reduction on Part L 2013</td>
<td>20% carbon reduction from renewables</td>
</tr>
<tr>
<td></td>
<td></td>
<td>‘Zero carbon’ from 2028</td>
</tr>
<tr>
<td>Guildford</td>
<td>20% reduction on Part L 2013</td>
<td></td>
</tr>
<tr>
<td>Eastleigh</td>
<td>19% reduction on Part L 2013</td>
<td></td>
</tr>
<tr>
<td>Oxford</td>
<td>19% reduction on Part L 2013 (adopted)</td>
<td>40% reduction on Part L 2013 (emerging)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% reduction from 2026</td>
</tr>
<tr>
<td></td>
<td></td>
<td>‘Zero Carbon’ from 2030</td>
</tr>
</tbody>
</table>

* source: Richard Twinn, Green Building Council
## Buildings Regulations

### Minimum requirements

<table>
<thead>
<tr>
<th>Location</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cambridge</strong></td>
<td>(19% reduction on 2013)</td>
</tr>
</tbody>
</table>
| **Greater Manchester (Emerging)** | 19% reduction on Part L 2013  
20% carbon reduction from renewables  
‘Zero carbon’ from 2028 |
| **Guildford (Emerging)** | 20% reduction on Part L 2013                                                        |
| **Eastleigh (Emerging)** | 19% reduction on Part L 2013                                                        |
| **Oxford (Emerging)**  | 19% reduction on Part L 2013 (adopted)  
40% reduction on Part L 2013 (emerging)  
50% reduction from 2026  
‘Zero Carbon’ from 2030 |

### Target Fabric Energy Efficiency (FEE)

- **Part L 2013**
  - 55 kWh/m²/year
  - A 19% reduction = 44 kWh/m²/yr
  - (The Black House = 38 kWh/m²/yr)

- A 40% reduction = 32 kWh/m²/yr

- Passivhaus 15 kWh/m²/yr

- ‘Zero Carbon’ from 2028

- 20% carbon reduction from renewables

### Local leadership:

- **Energy and carbon**
Performance Gap

60%-120% variation from design calculations:

gaps in assemblies
poor design- cold bridging
incorrect products
not airtight
discontinuous insulation
poor window installation
Performance Gap

Air permeability allowed
max 10 m³/m² @ 50 pa

Passivhaus requires
Max 0.6 m³/m² @ 50 pa

* source: Passivhaus Trust
Route to Zero Carbon

Figure 4 - Average new build energy demand vs Passivhaus

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>2020 ASHP with Storage Losses</th>
<th>Passivhaus with ASHP</th>
<th>Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>4000</td>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td>Hot Water</td>
<td>1000</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Lighting</td>
<td>500</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Aux Electricity</td>
<td>100</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Unregulated Energy</td>
<td>200</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Storage Losses</td>
<td>500</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Generation</td>
<td>14 solar panels</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Larch House
Bere:architects
### Transport links

<table>
<thead>
<tr>
<th></th>
<th>Million tonnes of oil equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total inland primary energy consumption</strong>&lt;sup&gt;1&lt;/sup&gt;:</td>
<td></td>
</tr>
<tr>
<td>Conversion losses:</td>
<td>53.8</td>
</tr>
<tr>
<td>Distribution losses and energy industry use:</td>
<td>66.4</td>
</tr>
<tr>
<td><strong>Total final energy consumption</strong>:</td>
<td>147.3</td>
</tr>
<tr>
<td><strong>Final consumption of which</strong>:</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>38.7</td>
</tr>
<tr>
<td>Domestic sector</td>
<td>40.8</td>
</tr>
<tr>
<td>Transport</td>
<td>48.6</td>
</tr>
<tr>
<td>Services&lt;sup&gt;2&lt;/sup&gt;</td>
<td>19.2</td>
</tr>
<tr>
<td><strong>Temperature corrected total inland consumption</strong>:</td>
<td>221.6</td>
</tr>
</tbody>
</table>

* source: Dept for Business, Energy & Industrial Strategy 2018

<sup>1</sup> Excludes non-energy use

<sup>2</sup> Includes agriculture

Primary energy consumption was 1.2% lower in 2017 than in 2016. The average temperature in 2017 was 0.3 degrees Celsius warmer than in 2016, though the summer months of July to September were cooler. On a temperature corrected basis, primary energy consumption was 0.3% lower than in 2016, continuing the general fall seen since 2005. In the last 30 years or so, consumption of natural gas and primary electricity has risen considerably, whilst consumption of oil and coal have fallen. However, over the past decade or so, consumption of bioenergy and waste has also grown.
50 m blocks with shops and business use

Solar shutters

Separate cycle route

Urbangreen

Public transport

Covered walkway
PRODUCTIVE ROOFTOPS

EXTERNAL TERRACES

CAR CLUB

SERVICE ZONE

NON-RESIDENTIAL GROUND FLOOR